Science I - Solutions

	1	2	3	4	5
1.			X		
2.					X
3.	X				
4.		X			
5.					X
6.					X
7.		X			
8.			X		
9.				X	
10.	X				
11.		X			
12.		X			
13.					X
14.		X			
15.				X	
16.		X			
17.		X			
18.	X				
19.				X	
20.		X			

	1	2	3	4	5
21.					X
22.			X		
23.		X			
24.		X			
25.	X				
26.				X	
27.		X			
28.				X	
29.				X	
30.			X		
31.		X			
32.			X		
33.	X				
34.			X		
35.			X		
36.				X	
37.				X	
38.					X
39.	X				
40.	X				

	1	2	3	4	5
41.					X
42.					X
43.			X		
44.					X
45.			X		
46.	X				
47.				X	
48.				X	
49.		X			
50.		X			
51.					X
52.		X			
53.					X
54.					X
55.					X
56.	X				
57.			X		
58.				X	
59.				X	
60.					X

INSTRUCTIONS FOR PAPER I

Biology II - Model Answers

Part A- *Structured Essays*

I A (i) A - photosystem II
B - photo system I
C - primary electron receptor
D - ATP
E - $NADPH_2$

(ii) Thylakoid membrane

(iii) ∘ chlorophyll a ∘ chlorophyll b • carotene ∘ santhophyll

(iv) The graph depicting the relative absorption of light by a pigment molecule at different wave lengths.

(v) Graph showing efficiency or rate of photosynthesis at different wave lengths

B (i) F - RuBP (Ribulose Biphosphate) G - RuBP Carboxylase
H - Phosphoglycerate (PGA) I - ATP
J - $NADPH_2$

(ii) Stroma of chloroplast

(iii) K - RuBp
L - PGA

(iv) M - Phosphoenolpyruvate (PEP)
N - PEP carboxylase

(v) Occurs in the cytoplasm of cells in the inner leaf.

C (i)

∘ Ribosomes	- synthesis of proteins
• Endoplasmic reticulum	- transport of proteins and lipids - lipid synthesis, detoxification - synthesis of steroids
• Golgi body	- collection, storage and distribution of molecules - synthesis of glycolipids/glycoproteins - production of lysosomes
∘ Mitochondria	- synthesis of ATP through aerobic respiration
∘ Lysosomes	- cellular digestion / storage of digestive enzymes

(ii)

Carbonic substances	Elements
∘ carbohydrate	C, H, O
∘ lipids	C, H, O
∘ proteins	C, H, O, N, S
• nucleic acids	C, H, O, N, P

D (i) Irreversible increase of the dry weight of an organism

(ii) (a) cell division - increase in the number of cells by mitosis
(b) enlargement of cells - irreversible increase in the number of cells
(c) cell differentiation - specialisation of cells

(iii) Progressive decline of the maximum functional level of individual cells and whole organisms

(iv) • genetic clock
• accumulation of random errors in DNA replication

- Mutations in somatic cells.
- Accumulation of metabolic by products.
- Formation of toxins due to environmental factors, sunlight, radiation, chemicals and
- Formation of oxygen containing free radicals during metabolism

2. (A) (i)
- The matrix being fluid in nature.
- Fibers are temporary / not frequently found.
- Cells of the tissue do not secrete matrix or fibers.

(ii)
- Distribution of excess heat / refraction of heat.
- Regulation of osmosis / regulation of constituents of water in cells.
- Helps prevent loss of blood / and fluids.
- Defense against microorganisms / foreign substances.
- Maintains physiological relations between tissues and organs.

(iii) • albumin • globulin • fibrinogen

(iv) fibrin

(v) 80 - 120 mg/100 ml

(B) (i) 4,500,000 / 5,000,000 (4.5×10^6 / 5×10^6)

(ii) bone marrow

(iii) erythropoietin

(iv)
- Being anuclear
- Biconcave shape / high ratio of surface to volume
- Bearing haemoglobin (any two of these)

(v)
- as bicarbonate ions • as carbamino haemoglobin
- dissolved in the blood plasma

(C) (i)

	cell tape	function
A -	Neutrophil	destroy bacteria
B -	Eosinophil	regulation of allergic reactions
C -	Lymphocyte	production of antibodies

(ii) basophils

(iii) lymphocytes

(iv)
- secretion of blood clotting factors
- association of Thromboplastine / thrombokinase with blood clotting

(v) dengue / chikungunya

(D) (i) is a protein (carbonic compound) that transports oxygen in blood

(ii) • haemoglobin • haemoerythrin • chloroquorine

(iii) haemocyanin

(iv) four

(v)
- haemoglobin has a higher affinity to carbon monoxide than to oxygen.
- forms stable carboxy haemoglobin by irreversibly reacting with CO.
- reduces formation of oxy-haemoglobin. Reduces haemoglobin available for oxygen transport

3. (A) (i) 0.4 (ii) 1120 KPa (iii) 1120 KPa (iv) 260 KPa (v) is less

(B) (i)
- Apoplast pathway : intra cellular spaces, system of interconnection of cell walls.
- Symplast pathway : across plasmodesmata, network of interconnected cyto plasm.
- Vacuolar pathway : route of water transport through vacuole to vacuole of adjacent cells

(ii) apoplasts

(iii) waterproof suberin is deposited in the form of solidification of Casparian strips in the endodermis

(iv) only selective absorption is allowed preventing the free movement of mineral ions

(v)
- transpiration/transpiration pressure
- gradient of water potential
- the cohesion force of water molecules
- the adhesion force of water molecules

(C) (i)
- humidity
- wind
- temperature
- light/sunlight
- free water in soil

(ii)
- Distribution of stomata / density of stomata
- Internal anatomy of leaf (sunken stomata / water storage tissues / more than one layer of palisade cells / thick cuticle)
- Amount of water contained in plant

(iii)
- Absorption of mineral ions / transport of mineral ions
- Cooling effect to the plant

(iv)
- leaves transformed into thorns
- Epidermal hair
- waxy cuticle
- sunken stomata
- shedding of leaves during dry or cold seasons

(D) (i) sucrose

(ii) transfer cells / transmission cells

(iii)

Element	Functions
N	is a constituent of proteins / enzymes/coenzymes / nucleic acids /chlorophyll For protein synthesis
P	constituent of nucleic acids / ATP / phospholipids / coenzymes
S	constituent of some amino acids / proteins
K	enzyme cofactor / to maintain solute potential, opening and closing of stomata
Ca	constituent of cell wall / middle lamella. Enzyme cofactor/for cellular permeability
Mg	constituent of chlorophyll / important as a activator of most enzymes

4. (A) (i) (a) 3.5 billion years ago (b) 480 million years ago (c) 420 million years ago (d) 500,000 years ago (e) 65 million years

(ii) Coelenterate / cnidaria

(iii)

Class	Animal
Hydrozoa	*Hydra / Obelia*
Scyphozoa	*Aurelia* / jelly fish
Anthozoa	Sea anemone

(iv) to certify an identity to a species as common names are variable.

(B) (i) (a) Pest population density that causes unbearable economic loss.
(b) Pest population density that calls for control measures.

(ii)
- Section of crop subjected to destruction
- Strain
- Economic value of crop
- Country / place
- Season
- Expense incurred

(any four)

(iii) Pest control using combination of two or more suitable control measures

(iv) Ability to reduce use of chemical compounds / chemical pesticides

(C) (i) yellow worm

(ii) Lepidoptera

(iii) Adult - sucking

Larva - biting and chewing

(iv)
- use of systemic pesticides
- manually removing eggs
- burning of remnants after harvesting
- keeping the field flooded for a few days.

(D) (i) The change in environment balance due to long term release of high levels of energy such as noise and heat, and chemical compounds that lead to the loss of quality of life harming people is known as environment pollution.

(ii) (a) leather factories - Cr

(b) textile factories - dyes. colouring

(iii) global warming

(iv)
- Destruction of forests - deforestation
- Burning of fossil fuels /release of green house gases
- Animal husbandry

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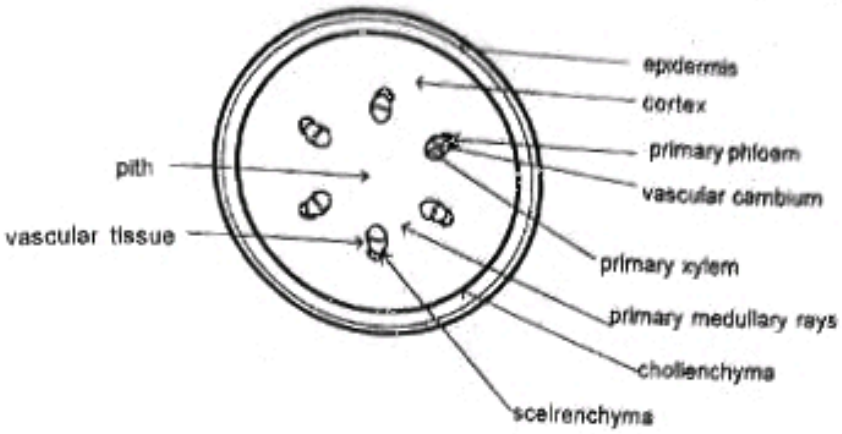
Part B - Essays

1 (a) **Primary structure of a dicotyledonous stem**

The epidermis is the outermost layer of the stem which is of a single cell layer. This is covered with a cuticle. The primary function of the epidermis is to protect the internal tissues. The cortex contains and outer layer of collenchyma and an inner layer of parenchyma cells. In addition, there may be cells containing chlorophyll in the outer layers. The cortex provides photosynthetic, protective and supportive functions.

There are several vascular bundles forming ring in the inner cortex. Each vascular bundle has inner xylem, an outer phloem and a vascular cambium in between. The outer covering of the vascular bundles consists of the sclerenchyma tissue. Xylem tissue transports water and minerals while the phloem transports sucrose.

The pith occupies the central part of the stem and is composed of thin walled parenchyma cells. The cells in the pith has a storage function.



Primary structure of stem

Parts that should be labeled:

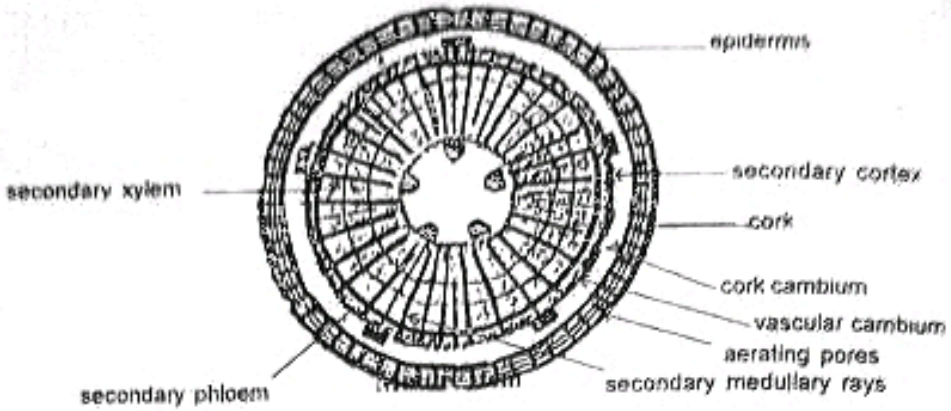
Epidermis	cortex	phloem	intra-phase cambium	xylem pith
Primary medullar rays	vascular tissue			

(b) First, the intra fascicular cambium in the vascular tissue gets activated. Some parenchyma cells in the primary medullary rays dedifferentiate to be meristematic and form the inter fascicular cambium.

The intra fascicular cambium and the inter fascicular cambium fuse to form the cambium ray. The cambial ring exhibits mitotic activity on both the sides. The mitotic activity on the inner surface results in the formation of cells, which differentiate into a set of xylem. It represents the secondary xylem. Similarly, the mitotic activity on the outer surface result in the formation of cells, which differentiate into a set of phloem. It represents the secondary phloem. Due to the formation of secondary xylem, the primary xylem becomes pushed more towards the pith and the pith gets slightly reduced. However, the secondary phloem grows and completely masks the primary phloem. Hence, it is not visible. Some strips of parenchyma cells formed by the vascular cambium become secondary medullary rays. As a result of the combination of the secondary xylem and phloem, the diameter (thickness) of the stem increases. As a result, the pressure that is built up will push the cortex cells and the peripheral tissues will be destroyed.

Some of the parenchyma cells in the peripheral layers of cortex undergo dedifferentiation and become meristematic. These cells now represent the cork cambium or phellogen. The mitotic activity on the inner surface of the cork cambium results in the formation of cells, which undergo differentiation into a living tissue, called secondary cortex or phelloderm, just above the primary cortex. The mitotic activity on the outer surface results in the formation of cells, which undergo differentiation into a dead tissue, called cork or phellem, just below the epidermis. The cork covers and masks the hypodermis. The tissue resulting from secondary growth in the cortex the cork, the cork cambium and the secondary cortex together represent a region called periderm. The periderm along with the primary cortex represents the bark. In several dicot plants, the bark peels off regularly. Due to the formation of periderm, the epidermis is subjected to pressure and as a result it breaks at several places to form openings called lenticels (aerating pores) , enclose a group of living cells called complementary cells. Through these cells exchange of respiratory gases and to some extent transpiration take place. Thus, secondary growth in the cortex result in the formation of periderm. Due to the addition of this region there is an increase in the girth of the cortex

Formation of annual rings results due to seasonality



Parts that should be labeled:

- Secondary xylem
- secondary phloem
- secondary cortex
- vascular cambium
- secondary medullary rays
- aerating pores / epidermis

2. (a) **Main factors that decide on the distribution of Sri Lankan forests.**
   - rainfall
   - temperature
   - height from sea level
   - soil profile / nature of soil

(b) **Distribution**

Tropical rain forests are distributed in the island in the south-west region of the wet zone at a height of 1200 m from sea level.

These tropical rain forests are found in Sinharaja / Kanneliya - Dediyagala - Nakiyadeniya /Gilimale - Erathna / Morapitiya - runakanda / Bambara botuwa

Characteristics:

- annual rainfall 2500 mm or more (rainfall increases from May to September)
- rains throughout the year
- Average temperature ranges from 27 - 30°. High humidity.
- the foliage shows stratification.
- trees are tall with stems. (pillar type stems)
- epiphytes are common
- trees are evergreen
- recycling is fast
- soil is infertile (mineral nutrients are lacking)
- high biodiversity
- shows high endemicity

Dominant species: *Dipterocarpus / Shorea / Mangifera / Dillenia / Mesua / Artocarpus*

(C) **Importance of forest conservation:**

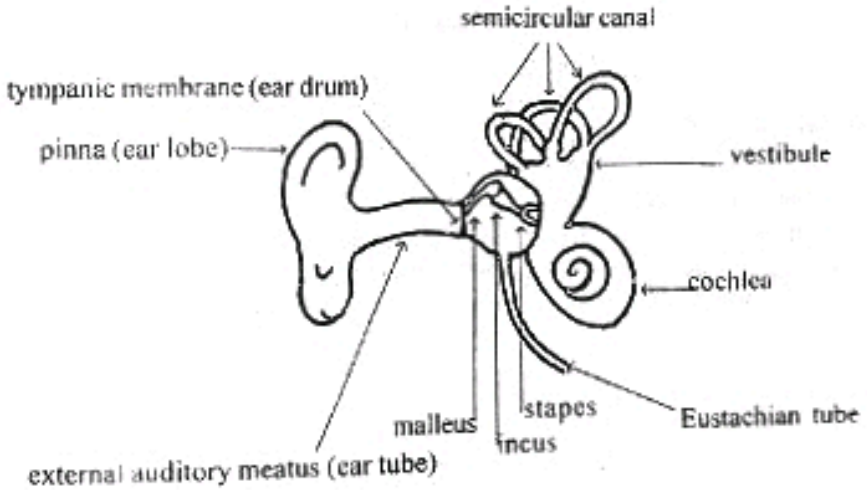
(1) Conservation of biodiversity / mono local species are conserved.
(2) Influence the climate
(3) Help to maintain Water cycle
(4) Function as water conservatory / protects from drying up of springs in the dry seasons
(5) Functions as wind shields
(6) Prevents soil erosion/protects from landslides
(7) Balance of oxygen and carbon dioxide in the atmosphere (controls)
(8) Aesthetic value

3. (a) The biochemical evolution of life was proposed by Oparin and Haldane. Life arose and evolved gradually on earth according to natural chemical and physical processes and laws. In the early stages the earth surface and the atmosphere was very different to what exists now. 4.5 billion years ago, there was no oxygen in the atmosphere of the earth. Gases such as hydrogen (H_2), methane (CH_4), water vapour ammonia (NH_3), hydrogen sulfide (H_2S) were found in the atmosphere. High level of UV radiation from the sun and the electrical discharges in the atmosphere caused the formation of carbonic compounds from these gases. Aggregations of such compounds led to the formation of first life forms. Nucleic acids became and important constituent of cells. Miller provided experimental evidence for this theory by simulation of the primitive earth in flasks.

(b) **Importance of DNA for sustenance of life and evolution**

DNA is the genetic material of all living organisms (except of some viruses). DNA is a macro molecule that is a polymer formed by the polymerization of deoxyribonucleic acid molecules. All cellular functions and hereditary patterns of life are controlled by the information stored in the nitrogenous base sequence of nucleotides in DNA. The auto replicating property of DNA generates genetically identical molecules that transmit genetic information through mitotic division. The continuity of life is thus ensured. DNA provides information required to synthesise biomolecules such as proteins, nucleic acids that are essential for life. The change in the sequence of the bases in DNA leading to mutations by the mixing of genetic information via crossing over during meiosis will give rise to genetic diversity. New variants will be formed. When these undergo natural selection, these new variants will form the basis for evolution.

4. (a)



Sketch of human ear

The human ear consists of three sections; the outer ear, middle ear and the inner ear.

The outer ear consists of the pinna (outer ear) and the external auditory meatus. The pinnae are located laterally on the head. The external auditory meatus is slightly curved and forms a 'S' shaped tube that runs the length between the external opening while many wax glands are found on the skin.

The middle ear lies between the outer ear and the inner ear. This is an air filled cavity behind the tympanic membrane (ear drum). There are 3 auditory ossicles (smallest bones in the body) namely, the malleus, incus and the stapes in the inner ear. There are two small openings, the round window and the oval window, between the middle ear and the inner ear. Malleus is connected to the tympanic membrane while the stapes is connected to the oval window. The incus lies between the malleus and the stapes. The middle ear is connected to the pharynx through the Eustachian tube.

The inner ear consists of the osseous and membranous labyrinths; the membranous labyrinth that is filled with perilymph, lies within the osseous labyrinth. The osseous labyrinth consists of three semi circular canals (in 3 planes, at right angles to each other), the vestibule and the cochlea. The membranous labyrinth consist 3 semicircular canals, utricle, saccule and the cochlear tube. Within the cochlea are three

fluid filled spaces: the upper vestibular canal, and the median cochlear canal and the lower tympanic canal. The Reissner's membrane lies between the vestibular and cochlear canals while the basilar membrane is found between the cochlear and tympanic canals. Basilar membrane contains sensory cells and nerves. The organ of Corti consists of sensory hair and nerve fibers of the basilar membrane. These hair are in contact with the tectorial membrane

(b) The human ear is sensitive to sound waves of the frequency range of 20-20000 Hz. The pinnae direct the sound waves through the external auditory meatus to the tympanic membrane. When the tympanic membrane vibrates, these waves traverse through the malleus to the incus and then to the stapes. Next the oval window starts to vibrate. The perilymph in the vestibular canal of the cochlea starts to vibrate. These vibrations are transmitted across the Reissner's membrane (vestibular membrane) to the endolymph in the cochlear canal. These vibrations travel to the basilar membrane, and then the sensory hair in the basilar membrane will touch the tectorial membrane and stimulate the nerve ends (sensory cells). The nerve impulses thus generated will travel to the cerebrum through the auditory nerve. The vibrations of the basilar membrane will be transmitted back to the perilymph in the cochlear canal. These vibrations will be transmitted back to the middle ear through the round window.

5. (a) **Extraction of copper from low grade metal ores**

The physiological activity of autotrophic Bacteria such *Thiobacillus ferroxidans*, *Thiobacillus thiooxidens* are used in the recovery of copper from low grade ores

The bacteria produce Fe^{+3} and H_2SO_4 and cause oxidation of the ore ($CuFeS_2$/iron), and immobilize copper as $CuSO_4$. This process is called microbial leaching and the solution of $CuSO_4$ is electrolysed to obtain copper.

(b) **Treatment of waste water by trickling filters**

The liquid flowing out of primary treatment enters the secondary treatment stage. In trickling filters waste water is slowly sprinkled or sprayed over a bed of rocky material (plastic pebbles) and allowed to trickle. In this process micro-organisms grow on the filter bed and oxidize organic matter. Treatment of waste water in this way will oxidize 75-95% of organic matter. Therefore, the biological oxygen demand (BOD) will reduce.

(c) **Pathogenicity**

Wounds on the human host provide points of entry to pathogenic microorganisms to enter and cause infection and disease in man. After entering the host, the pathogenicity (ability to cause disease on infecting the host) will depend on an environmental relationship between the host and the pathogen. This will be influenced by the dose of infecting microorganism, virulence, host resistance (nutrition and energy), host defense mechanisms. In order to prevent host resistance, a given microorganism must invade human cells and multiply in cells/tissues. Several extracellular enzymes produced by the pathogen, e.g phospholipase, lecithinase hyaluronidase, will help the pathogen to invade host cells/tissue, multiply therein and destroy these host cells/tissues. Some microorganisms produce and release exotoxins.

E.g. neurotoxins
Enterotoxins
Cytotoxins
Endotoxins

(a) **Structure and function of proteins in living cells**

Proteins are carbonic compounds with CHONS as constituent elements. These are polymers of amino acids. Proteins are synthesized by the various combinations of 20 amino acids through peptide bonds. There are 4 forms of protein structure. The peptide bonds between adjacent amino acids result in specific amino acid sequences that give rise to the primary structure of proteins. Hydrogen bonds help to form alpha - helices or beta-sheaths, that give rise to the secondary structure. Bending, folding of polypeptide chains produce the tertiary 'globular' shape. Aggregates of several polypeptide chains forming complex proteins give rise to the quaternary structure.

Proteins perform various functions:

Function	Example
Structural	keratin, collagen
Transport	haemoglobin
Storage	caseinogens, ovalbumin
Defence	immunoglobulin
Contraction	actine, myosin
Toxins	venom
Enzymes / activators	amylase / any enzyme
Hormones	insulin / any protein enzyme

(b) **Ex-situ conservation of species**

In ex-situ conservation the species is taken out of its environment into a specially created similar situation where its survival and reproduction are ensured. E.g. zoological gardens, botanical gardens, animal orphanages, genetic resource centers, gene banks, seed banks, field gene banks, artificial reproduction centers (reproduction in captivity)

(c) **Stomach secretions**

Secreted by stomach glands. Consist of water, minerals, hydrochloric acid, pepsinogen, mucus, internal factor, and a little lipase. Renin is also found in the infant stomach. Water helps to turn food into a liquid state. HCl helps to destroy the microorganisms in food. HCl helps in converting pepsinogen into pepsin, to deactivate tyalin, to provide an acidic / low pH medium (to activate pepsin). The mucus will lubricate the food and protect the stomach lining. The internalized factor helps to absorb vitamin B_{12}. Lipase enzyme acts on lipids. Rein will convert caseinogens into casein. Hormones such a gastrin and enterogastron and the nervous system will help regulate protein digestion.